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INVESTIGATION OF CONCRETE MATERIALS FOR FELSENTHAL AND "CALION LOCKS AND DAMS, OUACHITA AND BLACK RIVERS ARKANSAS AND LOUISIANA

Ьу

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August 1965

NATIONAL TECHNICAL INFORMATION SERVICE Springfield, Va. 22151

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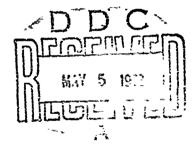
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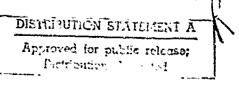
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Lower Mississippi Valley Division Materials and Concrete Laboratory

U. S. Army Engineer Waterways Experiment Station CORPS OF ENGINEERS

Vicksburg, Mississippi





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Foreword

The investigation covered by this report was authorized on 12 August 1964 by letter from the District Engineer, U. S. Army Engineer District, Vicksburg, Mississippi, subject, "Ouachita and Black Rivers, Arkansas and Louisiana - Funds for Laboratory Tests."

The work was performed at the Lower Mississippi Valley Division (IMVD) Materials and Concrete Laboratory, U. S. Army Engineer Waterways Experiment Station (WES), under the direction of Mr. Thomas B. Kennedy, and under the supervision of Mrs. Kutharine Mather and Messrs. Leonard Pepper and R. L. Curry. The report was prepared by Mr. Curry and Mr. Alan D. Buck.

Directors of WES during the investigation and the preparation of this report were Col. Alex G. Sutton, Jr., CE, and Col. John R. Gswalt, Jr., CE. Technical Director was Mr. J. B. Tiffany.

Contents

-	Page
Foreword	iii
Summary	vii
Introduction ,	1
Materiais	1
Tests	2
Results, Conclusions, and Recommendations	3
Results	3 3 4
Tables 1-3	
Plates 1-17	Ĵ
Appendix A: Petrographic Report	Al
Tables Al-A5	

Summary

In this investigation natural sand and gravel from five sources and water from two sources were tested for suitability for use in making concrete to be used in construction of Felsenthal and Calion Locks and Dams.

The results of the tests show that the aggregates from all of the sources are potentially reactive with the alkali in cement and would therefore require the use of low-alkali cement. The coarse aggregates from the St. Francis, Pine Bluff, and Ouach ta sources showed high sulfate soundness losses, but these losses seemed susceptible of reduction by thorough washing of the aggregates in water. The percentage of clay in the sand from the Monroe source was high, and this sand would also require thorough washing. The mortar-making properties test of the Pine Bluff sand indicated low strength percentages when the sand was tested as received, but the strength was satisfactory when the sand was tested after washing in water. The absorption was high on one of the Pine Bluff gravel samples. The water samples were satisfactory for use as mixing water in concrete.

It is recommended that all of the sources tested be listed as sources from which acceptable aggregate can be produced for the Felsenthal and Calion Locks and Dams, but that it be required that the material actually produced for use on these projects be graded and processed in such a manner as to meet the project specification requirements and that the absorption be less than 1.5 percent.

INVESTIGATION OF CONCRETE MATERIALS FOR FELSENTHAL AND CALION LOCKS AND DAMS, OUACHITA AND BLACK RIVERS ARKANSAS AND LOUISIANA

Introduction

1. This investigation was undertaken to evaluate aggregates for possible use in the construction of Felsenthal and Calion projects and possible future structures on the Ouachita and Black Rivers in Arkansas and Louisiana. The results of the investigation will form a part of "Design Memorandum No. 23 - Availability of Construction Materials, Felsenthal and Calion Locks and Dams."

Materials

2. Samples of natural fine and coarse aggregates were obtained from five sources, as follows:

Vicksburg District Source No.	WES Concrete Division Serial No.	Froducer, Location	Type of Sample
8	VICKS-26 S-1(2) G-1(4)	Ouachita Aggregate Co., Inc. Hampton, Ark.	Natural sand and No. 4 to 1-1/2-in. gravel
12	VICKS-26 S-2(2) G-2(2)	St. Francis Materials Co. Harrell, Ark.	Natural sand and No. 4 to 1-in. gravel
11	LR-18 S-1(2) VI_KS-23 G-1(2) G-1(3)	Pine Bluff Sand and Gravel Co. Pine Bluff, Ark.	Natural sand, No. 4 to 1-1/2-in. gravel, and sup- plemental gravel sample
13	VICKS-39 S-3 G-3	Standard Gravel Co. Camden, Ark.	Natural sand and No. 4 to 1-in. gravel
	Vicks-39 S-2 G-2	Monroe Sand and Gravel Co. Sterlington, La.	Natural sand and No. 4 to 1-1/2-in. gravel, and 1/2- to 2-in. gravel

Concrete mixing water samples were received from two sources, as follows:

WES Concrete Division Serial No.	Location
AICK8-98 M-T	Ouachita River, approximately 1 mile east of Calion Lock and Dam sine
VICKS-39 M-5	In Grand Marais Lake, approximately 2 miles south of Felsenthal Lock and Dam site

Tests

- 4. The materials were tested as follows:
 - a. Gravel and sand from each source were subjected to petrographic analysis by method CRD-C 127.*
 - b. Each size group of aggregate from each source was tested for reactivity with sodium hydroxide by the quick chemical method, CRD-C 128.

- c. Coarse and fine aggregates from each source were subjected to the following tests: sieve analysis (CKD-C 103); bulk specific gravity, saturated surface dry (CRD-C 107 or 108); absorption (CRD-C 107 or 108); soundness using magnesium sulfate (CRD-C 115); and clay lumps (CRD-C 118).
- d. Coarse aggregate from each source was tested for soft purticles (CRD-C 130), percent lighter than 2.40 specific gravity (CRD-C 122), percent flat and elegated particles (CRD-C 119), and box Angeles abrasion loss (CRD-C 117).
- e. Fine aggregate from each source was tested for organic impurities (CRD-C 121), percent lighter than 2.00 specific gravity (CRD-C 122), and mortar-making properties, i.e. compressive strength (CRD-C 11a).
- f. Pine Bluff sand and gravel were subjected to the following additional tests. A sample of the sand which was thoroughly washed in water to remove the fine silt was tested for mortar-making properties. The supplemental sample of the gravel, obtained at the site of production from which Felsenthal and Calion aggregates would be shipped, VICKS-23 G-1(3), was tested for magnesium sulfate soundness and Los Angeles abrasion loss.
- g. The two water samples were tested for suitability for use in mixing concrete (CRD-C 406).

^{*} U. S. Army Engineer Waterways Experiment Station, CE. <u>Handbook for Concrete and Cement</u>, with quarterly supplements (Vicksburg, Miss., August 1949).

5. Sand and gravel from Cuachita Aggregate Co. and St. Francis Material: to had been previously tested for use as construction materials for the Calion Pumping Station, and Pine Mulf sand and gravel for use in the Tlat Bayou Drainage Structure. Results of these tests are included in the data reported herein.

Results, Conclusions, and Recommendations

Resulta

- 6. The test results are given at the end of this report in the viving manner:
 - a. Lie results of the petrographic examination of the coarse and fine aggregate samples are reported in Appendix A and tables Al-A5.
 - b. Results of the chemical tests for reactivity of aggregate with sodium hydroxide are reported in plates 1-4.
 - c. Aggregate test data are reported in plates 5-12 and in table 1.
 - d. Results of the magnesium sulfate soundness tests of the aggregates are reported in plates 13-17.
 - e. Results of the tests of the two water samples are reported in tables 2 and 2.

Conclusions

- 7. The conclusions derived from this investigation are as follows:
 - a. Since one fine aggregate (LR-18 S-1) and all but one (VICKS-26 G-1(2)) of the coarse aggregates showed potential reactivity with sodium hydroxide, low-alkali cement should be used in concrete containing aggregates from the sources tested in this study.
 - b. The aggregate from each source will have to be regraded to meet Corps of Engineers Guide Specification grading requirements for concrete aggregate.
 - c. The Monroe sand will require washing to remove objectionable quantities of clay.
 - d. The Pine Bluff, St. Francis, and Ouachita aggregates will require washing and selective processing to insure that satisfactory sand and gravel are obtained from these sources. The high percentage loss in the sulfate soundness test of unwashed gravel, the low strengths of mortars containing unwashed sand, and the high Los Angeles abrasion loss of the unwashed gravel all showed improvement when washed samples

were tested. The 2.4 percent absorption of the latest shipment of Pine Bluff gravel appeared undesirably high, but the 1.2 percent absorption of the previous chipment indicates that properly selected and processed gravel from this source would have a satisfactory percent absorption. THE STATE OF THE PARTIES AND T

e. Based on the strengths of mortars made using the test water samples, water from these two sources would be satisfactory for use as mixing water in concrete.

Recommendations

8. It is recommended that all of the sources given in paragraph 2 be listed as sources from which acceptable aggregate can be produced for the Felsenthal and Calion Locks and Dams, but that it be required that the material actually produced for use on these projects be graded and proceed of the such a manner as to meet the project specification requirements and that the absorption be less than 1.5 percent.

Table 1

Results of Tests of Fine and Coarse Aggregates

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ahipment.	VICKS-26 S-1	2,60	1,0	7.0	;) C	:	-	;	:	C4	:	139	0£1
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Morten-making proportion of the fine aggregate are indicated by the compressive strength values. This refers to the organic impurities figure used in the test (CRD-C 121).

Table 2

Results of Tests of Water Sample VICKS-19 W-1 for Use in Mixing Concrete

Source of Sample: Cuachica River, approximately 1 mile east of Calion Lock

and Dam site

Test Method Used: CRD-C 406 Cement Used: Marquette Type III

Test Age days		Specimens Containing Test Water in Specimens Containing Distilled Water Specified Minimum
3	102	90
7	99	90

Table 3

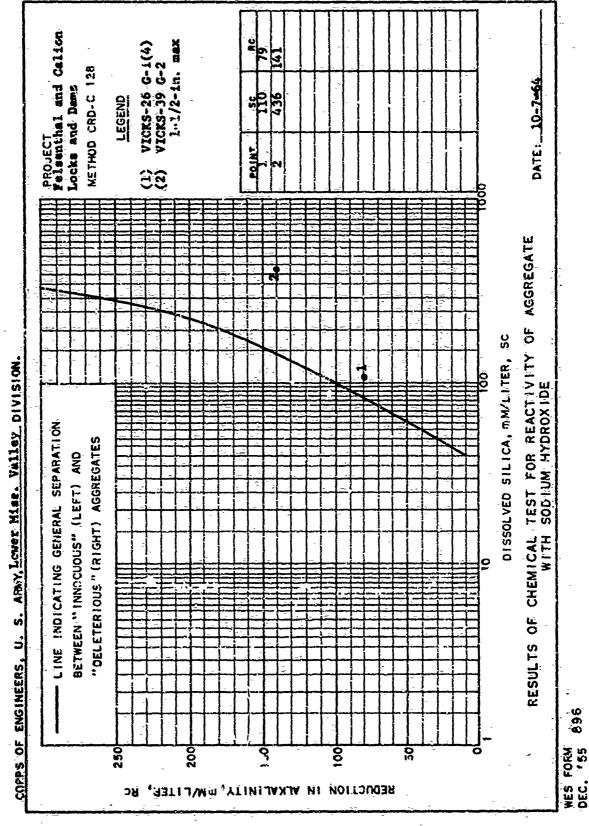
Results of Tests of Water Sample VICKS-39 W-2 for Use in Mixing Concrete

Source of Sample: Grand Marais Lake, approximately two miles south of

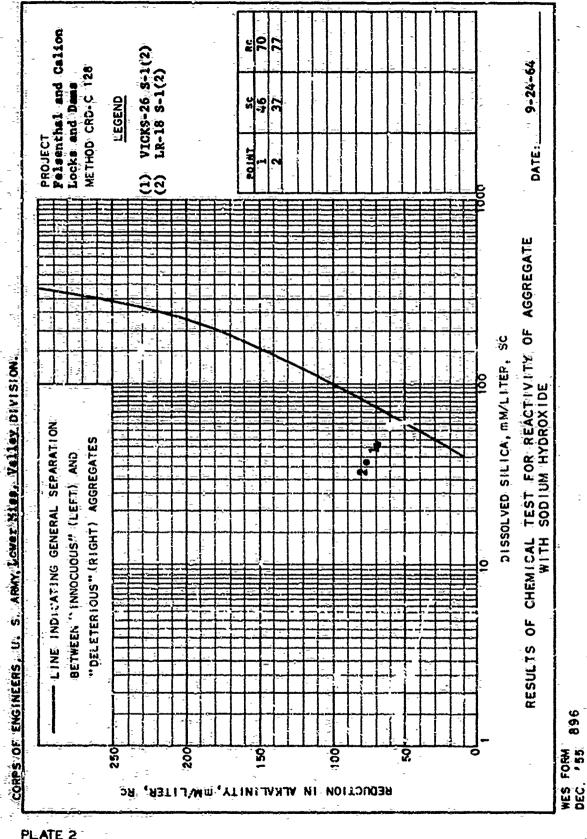
Felsenthal Lock and Dam site

Test Method Used: CRD-C 4C6 Cement Used: Marquette Type III

Test Age days	_	Specimens Containing Test Water in Specimens Containing Distilled Water Specified Minimum
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7	91	90

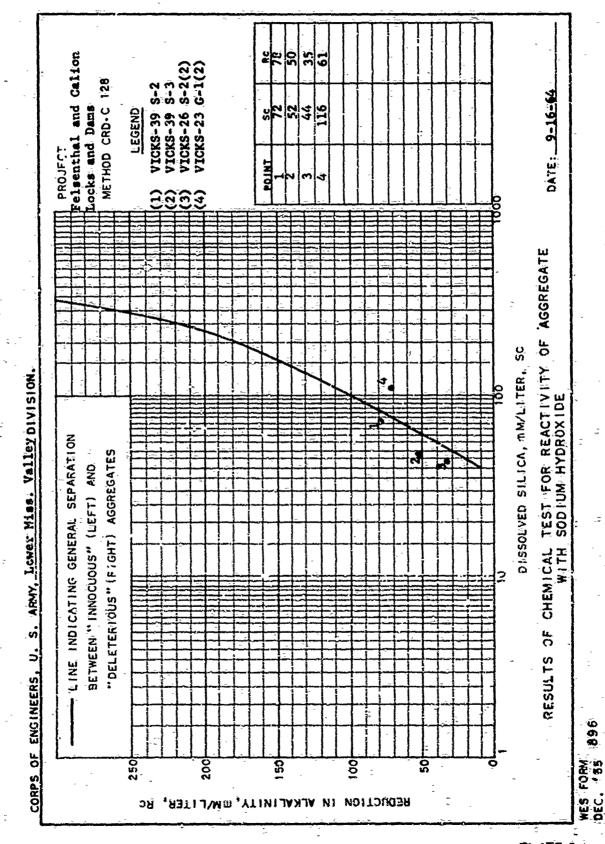


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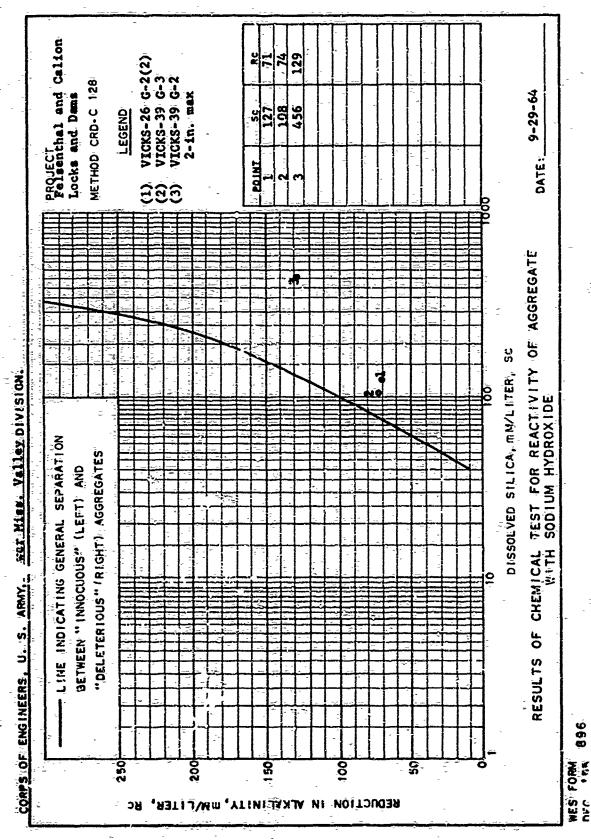


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F.M.(b)					2,20				_						$_{\perp}$		
(a) CAD-	C 105	(P)CI	D-C I	C4		MOSTA	R:								<u> </u>		
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FINE	 _	CONGR.	E 1 E (C)				iee.	<u>:</u>				F28	F		- -	-01	
FINE.		- A-		 		COARSE AGG! DFE 366 COARSE AGG: DFE 260							<u> </u>				
PETROGR		DATA (CRD-C	1275			ge Con	positi	On	(50	me c			nāc c	hert	in:	
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8530	T. F.G.O.	. vec	k tyj	<i>1</i> 00	-		1	_				2			• <u>•</u>		_
REMARKS	: #	The	grav	el s	hows	8. 100	ssibil	ity of	, Qt	let	erio	us:	resci	tivit	y ii	use	ed
- e*	1					i cem		•			•	= '	-		- ~-	,	-

WES FORM 726 JAN. 1951

Services well-Hill Ed(2); VICKS-23 G-1(2), G1(3)*** or waternathat, send and prayed control /b to 1/2 mile south of Hwy 79 on gravel crossroad, upproximately 2-1/2 miles west of Rearden Ark. **Proceedings Fine Blaff Sand and Gravel Co., Pine Bluff, Ark., Vicksburg District Source No. 11 **MARKER BY USARS/SS STATE FOR: Felsenthal and Calion locks and Dams ** **MONCESSANG SCFORE TESTING*** NOTE** **COLOGICAL TORNATION AND AGE** **COLOGICAL TORNATION AND AG	STATE: A	IK,			EX NO:	ندخت			REGAT						<u> </u>			
SCATORIS 1/2 to 1/2 mile scuth of Hay 79 on gravel crossroad, upproximately 2-1/2 miles west of Rearden Ark. District Source No. 11 District Source No. 12 District Source	LAT.: 3	3					-											
SCATORIS 1/2 to 1/2 mile scuth of Hay 79 on gravel crossroad, upproximately 2-1/2 miles west of Rearden Ark. District Source No. 11 District Source No. 12 District Source	LAB. 3YM	HOL IN	:juff-	8 S-1	(2);	VIC	KS-23.0	1-1(2),	G-1 (3)	YPE	OF	MATERI	N:NE	ıt.	bns	and	<i>p</i> rā	vel
2-1/2 miles west of Rearden, Ark. District Scurce No. 11 MARKED BY LISTAND AND AGE: District Scurce No. 11 MARKED BY LISTAND AND AGE: COMBING. (CAD-C 103)C(SW. TA NASSHO): SIEVE 3-6 '15-3' 2-15 'AA-15 'AAC. BULL 3-6 '15-3' 14-15																		
District Source No. 11									2-341- 8			LAVO	ببريد	نتهلك	-			
District Source No. 11 MARKET DET: CALLED									Pine	RI	wff	Δr	,	7501	cebur	· CT		
CAMPILED BY: USAEWES STORE FOR TOTAL STORE STORE FOR TOTAL STORE STORE FOR TESTING: NOTE							_01.400	<u> </u>	1 1110	בע	.ui i	2		1 4 4	LDUCK	<u> </u>		
COLORIGAL FORMATION AND AGE:					110.			<u>_</u>		<u> </u>								
COLOGICAL FORMATION AND ACE: CAMPING (CRD-C 103)(CISM-No PASSING): TEST RESULTS 3-6 13-3 1-6 13										-								
### CONDUCTOR FORMATION AND ACE: ### COMMING (CRD - C 103)(CINE - TO PASSING): ### SIEVE 3 - 6 7 13 - 5 1 2 - 13 4 - 13 6 16 16 16 16 16 16 16 16 16 16 16 16 1						l Ca	lion i	ocks	and Da	ns								
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GRADING (CRD-C103)(CLM. To MASSING): SIEVE 3-8" 13-3" 4-13" 14-13" 14-15" 14-1	<u> </u>														<u> i</u>	27	L	
SIEVE 3-6" 13-3" 2-13" MA-13" ACC. SIEVE 3-6" 13-3" 2-13" MA-13" ACC. SULM SP. CA, SAN SUM DNY (CRD-C 107,108): 10. ABSOMPTION, MER CENT (CRD-C 107,108): 2. 24 D. Q. SIN. GRAMAIC MEMBRITIES, FIG. NO. (CRD-C 120): 419. 310. PER CENT LIGHTER THING 3-CRZ_MO TIRD-C 1221: 310. PER CENT LIGHTER THING 3-CRZ_MO TIRD-C 1221: 3110. PER CENT TIRT AND ELONGATED (CRD-C 107,108): 2. 10. 2. 11. 2. 11. 2. 10. 2. 11. PER CENT TIRT AND ELONGATED (CRD-C 107,108): 2. 10. 2. 11. 2. 11. 2. 11. 2. 11. 2. 11. 3. 10. ABASSON LOSS (L. 2), 70, (CRD-C 117): 3. 0. 13C (1) -17, 74-13 (CRD-C 118): 3. 0. 10. 3. 11. 3.	CEOLOGIC	AL FOF	MATIO	AND	AGE:						,					1 1	L	
SIEVE 3-6" 13-3" 2-13" MA-13" ACC. SIEVE 3-6" 13-3" 2-13" MA-13" ACC. SULM SP. CA, SAN SUM DNY (CRD-C 107,108): 10. ABSOMPTION, MER CENT (CRD-C 107,108): 2. 24 D. Q. SIN. GRAMAIC MEMBRITIES, FIG. NO. (CRD-C 120): 419. 310. PER CENT LIGHTER THING 3-CRZ_MO TIRD-C 1221: 310. PER CENT LIGHTER THING 3-CRZ_MO TIRD-C 1221: 3110. PER CENT TIRT AND ELONGATED (CRD-C 107,108): 2. 10. 2. 11. 2. 11. 2. 10. 2. 11. PER CENT TIRT AND ELONGATED (CRD-C 107,108): 2. 10. 2. 11. 2. 11. 2. 11. 2. 11. 2. 11. 3. 10. ABASSON LOSS (L. 2), 70, (CRD-C 117): 3. 0. 13C (1) -17, 74-13 (CRD-C 118): 3. 0. 10. 3. 11. 3.							_									1		
SIEVE 3-6 13-5 2-15 44-15 AGC. BULK SP. CA., SAI SUME DRY (CRD-C 107,108): 2, 512, 66 SIN.	GRADING	(CRD	C 103	(CLM.	To MS	SHIG):	-	TE	ST RES	SUL	TS					0.1127		
SIEVE 3-6 19-3 2-15 Acc. BURN SP. CA, SRY SUMP DRY (CRD-C 107,106): 2,54,260				Ţ		FINE	Į.				لت			3-6	15-3		1	* : ***
ABSORPTION, PER CENT (CRD-C 107, 106): 2, 1, 0, 0 5181 0000000000000000000000000000000000	SIEVE	3-6"	17-2	3-15	-4-15		BLE K SP	CA. SKI	SUMF DRY	(CRI	D-C I	07.108)	: -		-			
SIN. ORGANIC INFURITIES, FIG. NO. (CRD-C 12):	4 IV				-					ښب							$\overline{}$	j
SOUT FARTICLES, PER CENT (CRD-C 1301: 0.0		<u>ت</u> به م				<u> </u>				_							بعجا	ا-لا با
Sin.			<u> </u>														15	+
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111	14116		17		100		ABRASIO	LOSS (Â.), Po, (CHD)-C_II	7) <u>i</u>	ات_			30.	136	9
\$10.	IIN.				94		UNIT_WT	., LB/CU	T (CRO-	C 10	6):		,	-				
\$10.	JIH.			-	77		CLAY LU	MPS, 70 (CAD-C 11	6) :							0.1	0.4
	JIN.	-			40		PER CE	NT LIGH	TER THA	N 51	P. 61	2.00 (RD.	: 122):			-	-0.0
NO.4 7 98 REACTIVITY WITH NOON (CRD-C 128) Sc, TMAT. 116 37 NO.8 85 85 MAIS 66 MORTAN-MAUNG PROPERTIES (CRD-C 118) NO.30 35 TYPE WASHING EMENT, RATIO 5 DAYS, 314 3, 7 DAYS, 412 3 NO.50 19 LINEAR THERMAL EXPANSION XIO POEC. F. (CRD-C 125,128): NO.200 2 2 ROCK TYPE PARALLEL ACKOSS 3N AVERAGE NO.200 2 2 ROCK TYPE PARALLEL ACKOSS 3N AVERAGE ACRORAR-BAR EMENSION AT NOOF, 76 (CRD-C 123): SINE AGGREGATE COARSE AGGREGATE ACRORAR-BAR EMENSION AT NOOF, 76 (CRD-C 123): HIGH-ALK CEMENT: 76 Na ₂ O EQUIVALENT: HIGH-ALK CEME	114.					100	SPECIFIC	HEAT, BY	WLB/CEG	F. (CRD-	C 124):		-			1	1
NO. 8					7											_ئنست	1176	1 37
MAIS								•••							 			
NO.30 55 TYPEWASHEDEMENT, RATIO DAYS, 314 % 7 DAYS, 112 % NO.50 10 LINEAR THERMAL EXPANSION XIO *DEC. F. (CRD-C 125,126): NO.100 2 ROCK TYPE PARALLEL ACROSS 3N AYENACE NO.200							4479749	- NAMING I		• 11	-00-					ستت	1 51	إسالنات
NO.50 19 LINEAR THERMAL EXPANSION XIO POEC. F. (CRD-C 125,126): NO.100 2 ROCK TYPE PARALLEL ACROSS ON AVERACE NO.200 1.2 ROCK TYPE PARALLEL ACROSS ON AVERACE F.M.(6) P.75 MORTAR: SOUTHAR-BAR EXPANSION AT MOF, 70 (CRD-C 125): 3 MG 6 MG 9 MG 12 MG 5 MG 6 MG 9 MG 12 MG LOW-ALR CEMENT: 70 No.0 ECHWALENT: NO.0 ECHWALENT: ROUNDINGSS IN CONCRETE (CRD-C 40, 114): FAT HW-CD HD-CW FINE AGG COARSE AGG: DFE 300 FINE AGG COARSE AGG: DFE 300 CONSTITUENTS PErcentage Composition Gravel CONSTITUENTS 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert 89 86 34 Quartz 11 13 63 Sandstone, quartzite, and SSSORTED TOCK types Trace 1 3																		
NO.100 2 ROCK TYPE PARALLEL ACROSS SH AVERACE NO.200 1.2	NO.30 55 TYPEWASHECEMENT, RATIO DAYS, 314 % DAYS, 112 %																	
NO.200		^ _			-	19	LINEAR			ON	,		*					
Tage of the concrete (cro-c 121): Percentage Composition Constituents 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert 99 86 34 Constituents 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert 99 86 34 Constituents 11.2 Constituents 34 Sandstone, quartzite, and sssorted rock types Trace 12.3 MORTAR: SINE AGGREGATE COARSE AGGREGATE COARSE AGGREGATE SINE AGGREGATE COARSE AGGREGATE COARSE AGGREGATE SINE AGGREGATE COARSE AGGREGATE COARSE AGGREGATE SINE AGGREGATE COARSE AGGREGATE COARSE AGGREGATE COARSE AGGREGATE F & T HW - CD HD - CW FRE AGGREGATE COARSE AGGREGATE F & T HW - CD HD - CW Gravel 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert 39 86 34 Chert 39 86 34 Chert 31 13 63			<u> </u>	<u> </u>		2	 	ROCK	TYPE		FAR	ALLEL	AC	NO53			AVE	wa
F.M. CONTAR-BAR EMERISSION AT HOOF, To (CRD-C 123): LOW-ALE CEMENT: HIGH-ALE CEMENT: TO NO COUNTAR AGG: FIRE AGG: TO STE 300 TO STE 30					I		 								J			
CONSTITUENTS STATE OF STATE OF STATE AGGREGATE COMPANY ACCURATE (CRD-C 40, 114): FINE AGG. COMPANY AGG: COMPANY AGGREGATE COMPOSITION CONSTITUENTS 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert 89 86 34 Quartz 11 13 63 Sandstone, quartzite, and assorted rock types Trace 1 3					L	1.3	<u> </u>				L				E			
ACRTAR-BAR EXERCISION AT 160F, To (CRD-C 123): LOW-ALK CEMENT: To No 0 EQUIVALENT: HIGH-ALK CEMENT: To No 10 EQUIVALENT: HIGH-ALK CEMENT: To No 10 EQUIVALENT: HIGH-ALK CEMENT: To No 10 EQUIVALENT: FINE AGG. COARSE AGG: COARSE AG	L'W(P)					2.75					<u>L_</u>				İ		***	النب
LOW-ALK CEMENT: % No COUNTENT: HIGH-ALK CEMENT: % No 10 EQUIVALENT: FINE AGG. COARSE AGG: DFE 300 ETRICORAPHIC DATA (CRD-C 127): Percentage Composition Gravel Constituents 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert 89 86 34 Quartz Chart 11 13 63 Sandstone, quartzite, and assorted rock types Trace 1 3	(+) CRD-(105	(F) CI	10-C	04		MORTA	R:										
LOW-ALR CEMENT: % No. 10 COUNMLENT: HIGH-ALR CEMENT: % No. 10 COUNMLENT: HOUNDMESS IN CONCRETE (CRD-C 40, 114): FINE AGG. COARSE AGG: OFE 300 FETROGRAPHE DATA (CRD-C 127): Percentage Composition Gravel Constituents 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert Quartz Sandstone, quartzite, and assorted rock types Trace Trace 1 3	-				:			-	SINE AG	GREC	SATE		7		COARSE	AGGRE	GATE	
HIGH-ALK CEMENT: % No.10 EQUIMALENT: NOUNDHESS IN CONCRETE (CRD-C 40, 114): FINE AGG. COARSE AGG: OFE 300 PETROCRAPHIC DATA (CRD-C 127): Percentage Composition Gravel Constituents 3/4 - 1-1/2 in. No. 4 - 3/4 in. Sand Chert Quartz Chert Quartz Sandstone, quartzite, and assorted rock types Trace 1 3	- KATROM	PAN ÉX	FKISIO	M AT-X	/CF, 70	(CRD-	Æ 123):	3 MQ	6 MO.	•	MO.	12 MC	1 3	MC	6 MO		MD.	12 MQ.
FINE AGG. COARSE AGG: OFE 300 COARSE AGG: OFE	LOW-A	LK CEN	ENT:		To Na,	O EQUI	WALENT:						1			1		
FINE AGG. COARSE AGG: OFE 300 COARSE AGG: OFE	HIGH-A	LKCI	ENT:		To No.	O ESU	WLENT:						1			+	-	
FINE AGG. COMPSE AGG: COMPSE			-	حضرصم				<u> </u>				بيبرسين			F 3 T	HW	cn:	HD- CW
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Quartz 11 13 63 Sandstone, quartzite, and sscorted rock types Trace 1 3		تبينت	غالناه	للتهدي			<u> </u>		·	•			يهت		÷		_	
Sandstone, quartzite, and assorted rock types Trace 1 3	Chert		-						-							34		
assorted rock types Trace 1 3			<u>-</u>		-			11				1	3			53		
dozor ver voer of pen	Sands	tone	, qu	artzi	ite,	and					-							
A CONTRACT OF THE PROPERTY OF	3550	rted	roci	k tyr	es	_		Trac	2				1			3		
The gravel shows a high magnesium sulfate loss and a possibility of					_	2 2	nigh r	venes.	בוסי רווו) fr	te	1055	and	1 2 1	12200	b 113	tv.	of
leleterious reactivity if used with a high-alkali cement. The sand shows low																		
strength in mortar as compared with mortar containing standard Ottava sand.																		
Soundness and mortar strength were satisfactory in Fashed samples.	SUMM	เดรอ	and	WOX.E	ar s	ř. sú	Ren A	re sa	ererec	COX	A 3	II AR	eng	z SE	mores	,		

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						Ark.			_								
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					FINE	ł	1	.J		-21			3-6"	11-3			AGG.
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NO.16					_64			PROFERTIE	_		-			~			. 1
NO.30 55 TYPE IIICEMENT- RATIO 3 DAYS, 125 % 7 DAYS, 121 %																	
NO.50		L			<u> </u>	LINEAR			CN	XIO 9	DEG F.	(CRI)-C 12	5,126):]
NO. 100					_6		ROCK	TYPE		PARJ	LLEL	ACI	ROSS	0	٠	AVE	WGE
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			~ ~ N	Te		- 1231.	3 MQ.	6 MO.	9	MO.	(5 MC). 3	MO.	6 MO	. 0	NO.	12 MO.
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HIGH-	A M.CEA	AENT:		To Neg	O :EQU	VALENT:	<u> </u>								I		
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FINE	AGG.					COARSE A	co:					DF	1		\mathcal{I}^{-}		
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-	_						فحيحم		'av		 -	<u> </u>	,				į
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wss-form 726 Jan. 195

STATE:	La.		LONG: 92 DATA SHEET DATE: Nov. 1964 VICKS-39 S-2, G-2 TYPE OF MATERIAL: Not. sand and grave1														
LAT.:	32		LON	1G.: C	2		DATA	SHEE	T	DATE	_Nor	7.19	64				
LAG. SYM	BOL NO).: V	ICKS-	39.8	-2.	G-2			YPE	OF I	MATERI	AL: N	Δŧ.	sand	and	ora	ve1
LOCATION	: 1/	2 mi	le ve	est c	f St	erlin	gton.	south	on	ble	okto	ופ. מי	ni a	ravai	ros	3 /}	
		~ · · · · · · · · · · · · · · · · · · ·		,,,,			24XIII	V.V.W.Y.	-X11		CATVAN	ستني			- 4.3/3	***	
PRODUCE	i Mo	N 2000	Cond	1 000	Cws	3 C	o 64	erling	+ ~	~ T							
	· PIO	moe	- E) 021C	r ann	Ure	rver C	<u>U </u>	GULLIN	, LC	اسعاد	154						

SAMPLED								-تىنىنى	~								
					Cal	ion L	ocks_a	nd Dar	18				<u></u> .	~=			
PROCESSI	NG BEF	ORE TI	ESTING:	No	ne												
<u> </u>																	
GENLOCIC	AL FOR	MATION	AND	AGE:													
			7											-			
GRADING	(CRD	C 103)	(CUM.	70 JAS	SING).		TE	ST RES	SUL	TS			7-47	13-3-	2.2	-4-11	FINE
				10	FINE	-	<u></u>	SURF DRY	•			.	3-6	,,,-3	(c)	(c)	AGG.
SIËVE	3-6	12 - 3.	1/2-2	-4-13	AGG.	BULK SP.	. CA , SAT	SURF DRY	(CRI	D-C 1	07,108)	;		7			2.60
GIN.						ABSORPT	ION, PER C	ENT (C.ID.	·C 1	07,10	5):	+		7			0.9
SIN.	 	<u> </u>	-	r		<u> </u>		S, FiG. NO						<u> </u>			5
4IN.	 -	<u> </u>	-	 				PEŘ ČENT						 	0.0	0 0	十二十
31N.				 				R THAN S				.لــــــــــــــــــــــــــــــــــــ	127		6.8		
2j IN.	 							NO ELONG							2.8		
	ــــــــــــــــــــــــــــــــــــــ		 										(200				
ZIN.			100					055, 5 CYC				4-\$)(CRD-				3.2
i in.				96		-		A.j. %,			7).			1 4	1.2	21.	4
3 IN.			42	64				ET (CRD-						<u> </u>			+
IN.			20	38		PER CE	NT LIGH	TER THA	N SP	. GR.	2.00 10	GRD-C	116).	*	0.1	<u>0.1</u>	
ĮIN.			_3	14		COAL AN	D LIGNITE	, % (CRO	-c	122);							p.o
ŽIN.		-		6	100	SPECIFIC	MEAT, BT	U/LB/DEG.	F. (CRD-	C (24)						
NO.4				- 0	92	REACTIV	ITY WITH	NáOH (C	RD-	C-126). Sc,-	TM/L		- 1	156	436	72
NO.8					$\delta 1$	I				*	Rc,	WL:			129		78
NO.16					7Ó.	MORTAR-	-MAKING	PROPERTIE	\$ (0	:RD- (C 116)						
NO.30			47 TYPE TIL CEMENT, RATIS 3 DAYS, 133 % 7 DAYS, 130 %														
NO.50			}		18			EXPANS									
130,100			<u> </u>	 -	5	1	ROCK				LLEL	,	2055	JNC I	Т	AVER	AGE :
NG.200			-			 				 		-]
- 200 ^(e)		 			, ,	i				<u>} </u>		 		! -	-+		→ !
F,M(6)					60	i	·			 				 	 i-		~
	·	<u></u>	<u></u>		R. 88					L		L		<u> </u>			
(e) CRD-	C 105	(P) CF	10-C 1	U-4		ATRCM	M:	#44.P									
MORYAR -	BÁR EX	MANSIO	N AT K	00F. 70	(CRD-	C 123)		FINE AG						COARSE			
<u> </u>							3 MO.	5 40,	,	wa.	12 M	7 3	MO.	6 MO.	9	MO.	12 MQ
	NLK. CEN					VALENT:						┵			4		l
HIGH-	ALFI, CEN	MENT:		% Noz	O EGUT	VALENT:	L										
SOUNDNE	35 44	CONCR	ETE (CF	10-C	10, 114):		-						FAT	HW-	·co	нр-см
FINE	AGG.					COARSE A	cc:					DFE	360				
FINE	AGG.					COARSE A	cc:					DFE	360				
PETROGR	APHIC	DATA (CRD-C	127):	Perc	entage	2 Comp	ositio	n (SOM	e c³,	alce	don	ie ch	erť	in :	cand)
l				~		•	_			-							
1	_		_			-14-2			ray	<u>vel</u>	<u></u>	- N		-	_		j
<u> </u>	Con	stit	uent	s		3/4	<u>- 1-1</u>	/2 in.		NO.	4 -	3/4	in	<u>. 'Sa</u>	aug.		ł
Chert		-	-			_	96	-			9	О			51		3
Quart							ĩ	_			-	9			71		1
Sands		. Ons	ırtzi	te.	and		_					-			. —		
2580			-	•	~~~~		3					1			5		
Felds			. vj.p	~~											5		1
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REMARKS	•							ty of									
			_	n-al	kali	cemer	nt. T	he per	cer	stag	e of	cla	y l	umps	in t	he a	sand
	i;	: hia	<u> h</u>														

STATE:	rk.	-	IND	EX NO.	2(Re	v #2)	AGG	REGATI	E 71	ESTE	D BY:	is/	AEWES				
LAT.:	33 -		FOV	IG.: 1	92		DATA	SHEE	To	ATE:	28 1	lar	ch 19	257.	29 S	ent	1958
LAB. SYM	50L N	o.: VI(KS-2	6 G-	1(2)	,S-1 J	оъ 600) <u>1/308</u> 1	YPE C	¥ M	ATERI	Ų:	Nati	irai	grav	e.	
LOCATION	: Pit	on	Nett	les	prop	erty,	5 mi	of H	ampt	on,	Arl	٠.,	4 m	W c	f Hw	y 10	57.
					_	_								******			
PRODUCE	F: Or	iachi	ta G	rave	1 Co	mpany.	Nett	les Pi	ŧ.							_	
	-	_			,		-										
SAMPLED	BY: \	/icks	burg	Dis	tric	t											_
						Works	!		-								
PROCEST					one												
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								-									
GEOLO/310	AL FO	NATIO	GNA N	AGE-	Rec	ent Al	luvia	_									
USED :	IN:	Culi	on P	umpi		tation											-
GRADING								ST RE	SULT:	s T				11-3"			FINE
			04-13"	35	FINE								3-6	13-3	(c)	(c)	AGG.
SIEVE	3-6"	13-3	F4-13	-4-2	ACS,	BULK SP.	UR, SAT	SURF DRY	(ČĐĐ-	č 10	7,108)	:			2.50		12.6
SIN.		1						ENT (CRD-				-			1 3		1.1.
SIN.			 		<u> </u>	DRCANIC	IMPURIT:	S. FIG. NO	(C50	-C 1	21):					1=	- 2
4IN.						SOFT PA	RTICLES,	PER CENT	(CRO-	C 13	(0)		<u> </u>		0.2		7=
3IN.		 	†		 			R THÂN SI				29):	 			1	1
25 IN.		1	†			PER CEN	FLAT A	NO ELONG	TĈD (C	-6s	C 119,	20).	t		2	1	1
ZIN.			1			WEIGHTE	0 AV. % U	055, 5 CYC	MgSO,	((c)	\$ -1°, 0	4-4	(CRO-	C 115)	1C. 6	-	7
1 in.		1	100		<u> </u>			A.), %, i					1	ī	27.	,	1===
T.IN.		 	93			UNIT WI	, LB/CU	1 (CRD-	(90.	:			1	i —		1	1-
zin.	<u> </u>		. 72			CLAY LU	MPS, %	CKO-C II	g).				 -	 		1	1
in.	-		35		 -	COAL AN	D LIGNITE	, % (CRC	~C 12:	2):		****				1=	
₹:N.	-	1	10		 -	SPECIFIC	FEAT, BT	U/LB/CEG.	F. (C9	1D-C	:24).		i	i –		 	1
NO.4		<u> </u>	T = 3		90	J		Nook (C					 -	1	164		60
NC.8		 	i		79	†					Rc,n		<u> </u>		178		7 80
NO.16		1	1		60	MORTAR-	MAKING	PROPERTIE	S (CR	D-C	116)	••	<u>. </u>				
NO 30	<u> </u>	 	 	 	110	TYPE_I	II CEM	N'C, RATH	_3_ه	04	YS <u>. </u>	139	_%	_7_	DAYS,_	1	<u>30. ~</u>
NO.50	 	 	 	i	21			EXPANS									
NO. 100		 	 	$\overline{}$	2		ROCK	TYPS	F	ARA:	LLEL	AC	POSS	1 0	N	AVE	AGE
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- 200(0)			Γ		0.8			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	_					i			
F, 14 (6)		1	 		270	1!		····	j			_		i		~~ ·	
(a) CRD-		(b) C	30-C :	느 04		NORTA	R:								,L		J
<u> </u>						-		FINE AG	GREGA	T E.	· · · · · · · · · · · · · · · · · · ·	7~	·	CZ-RSS	AGGR	EGATE	
MORTAR-	BAN F	XPANSIC	H 22 H	00F, 70	(CHD	-C 123):	s MO.	6 NO.	9 14	o. ;	12 VC	13	MO.	5 MO	9	MO.	12 N.2
LOW-	LH, CE	MENT:		% No.	O EQU	VALENT:				_		1			1		
HIGH-	ALK CE	MENT:				NELEHT:				寸		7		<u> </u>			
SOUNDNE	53 IN	CONCR	ETE (CI	3- G	40, 114);	·	·	·	<u></u> -				FET	нw	-cn	Hu-C:V
FIRE	<u> </u>					COAPSE A	66:	~ 				DF	F 300			/ j	
First	AGG.			····		COARSE A	GS						E soc	 	<u> </u>		
PETROGR		DATA	(CRD-C	127):												1	
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1	Assu.		ب د در	V#1/48	4	7 00-6	. w w.i. v 7	المؤرزة من		** 1	-	باد د هند	101	5-4 ± C	· · · · · · · · · · · · · · · · · · ·	_	
Ì		L41 <u>65</u> -															
Ì		-													-		
REMARKS	i kis			3*-	j.	m /), 3"		3	3		37		^^				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
i								decant									
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E			-		neer'	over	n). 2	W. T	ae t	೦೮೮	¥ %	1 /4.	soln	g tne	HO.	£	•
sieve	was	rue	1 0.3						-		·						شر سيسيث

						I	ຮຮນອດີ	Sept	<u>1958</u>					·		
STATE:	irk.		INC	A NO:	3		AGG	REGATI	76	STED	er: US	AEWES	3			
LAT.	33		LO	G.i	92	_	DATA	SHEE	T DA	ITE:	19 Ju	ily 19	957			
LAB. SYM).:1/T/c	KG : 2	6 9-	2 4	-2 Tol								grat	reil	
LOCATION	: Har	rall	e Di	1. to	الاحتواء الاحتواء	iles r	orth	of Gor	rell	۸r	kence	e	_====	<u>-,, </u>	<u> </u>	
			<u> </u>	<u> </u>	#O 11	++(3.1	01 011	1100		2 -13-	Ruise					
PRODUCE	. 03	20.		n 11e	Laves.	-l- C-										
	. 50	·, r:	mic1	s ma	reit	81 S C	Ausduc				·					
جحننا	·															
SAMPLED	6 5.: 1	<u>licks</u>	buce	Dis	tric	<u>t</u>										
TESTED	FOR:	Calic	n Pr	otec	tion	Work:	·									
PROCESS	NG BEF	ORE T	ESTING:	Non	ę											
			-													
GEOLOGIC	AL FOR	ACI TAM	AND	AGE:										-		
USED	***	0-15	on F	2003		1105	<i>-</i> 1									
GRADING								ež ore	2117		···	7				TINE
1							- 1-6	ST RES	OL1:	נב		3-5"	13-3			AGG.
31EVE	3-6~	14-3"	3-15"	#4-}*	FINE							- 	i	(c)	(c)	
	 						CE, SAY				(09):	· j			1-5	62.62
6IN.	<u></u>	L	<u> </u>				adm, per c					 			عبلا	لكدنه
5111.							in Punistic								<u> </u>	- 2
4110.	ļ	l	<u> </u>				aticles,					1	jj		0	1
3IN.			i			PER CEN	T LICHTS	THU S	(NZ.	4V10	10.C 17	2):			14	11
2 1N.			<u> </u>			PER CEN	F FLAT A	S EFONC	CD (C	AD-C	119,120).	1			19	
ZIN.			 			WEISHTE	D AV. % L	SS. S CYC	MaSQ.	(Se) 4.	7. •4-1)(CRD-	C 1153		16	6 6.8
IIIN -	ļ		 !	100			LOSS (L					7			12	
17N.							., LB/CU í					 			<u> </u>	
314	<u> </u>	<u> </u>	 	33			****** *** (┼~	
	}	<u> </u>	 	62		<u></u>	~~~~						<u> </u>		┼	
JIN .			 	24			O LIGNITE					1=			ļ ~~~	다
IN:	<u> </u>	<u>L</u>		7			HEAT, GT					1			<u> </u>	<u> </u>
NO 4	<u></u>	<u> </u>		0	99	REACTIV	TY WITH	HOOH (0	3-CA	126)	5c,muz	-1			1	
8 0M	Í	1	i		_80	ł					Ac, MM/L				L	1
NG.16	1		(MAKING I									
NO 30			<u> </u>		56	TYPE	III	NT, PATE	يتسد	_ DA- 1	110	?.ત્ર	7	DAYS,	750	74
NO 50			 	<u>' </u>	18	LINEAR	THERWAL	EXPANS	ON XI	o POE	5 **	10-C 12	5,196)			
NO.100	 	 	ļ	-		-	Sec.		0	ARALL	51	77752	T ~~~	, 7	4v:	54
NO.200		 -				 			~ -				 -	~		
- 200 ⁽⁴⁾	h·		ļ		~~~						- -		 	i		
- E M(P)		!	ـــــتحِ إِ		0.1	 						·	i -			
	i	تحصية	ــــــ	<u> </u>	e. 82	L					i_		<u> </u>			
(=) CRD-	C 105	(ЮС	3D-C (74		MERGIA	P:	<u> </u>								
MOSTAR-	BAR E	(FANSIO	N AT I	00F. %	(CRD	ا وقت ما		FINE AS		21			COARSE	AGGR	ECATE,	
							3 VO	6 MO.	9 M) 12	MO.	3 MO	6 WO	18	MO ,	18 140.
LOW-	ALM. CE	AENT:		la Na	O EQU	VALENT:				_			<u> </u>	1.		
HIGH-	ALK CE	HENT:		7u Naz	o Equa	VALENT:				1					1	
SCUNDNE	55 14	CONCP	ETE (C	3-01	40, 114):							FAT	1. 4	-60	43-CW
FINE	AGG,					COAPSE A	.cc:				5	FE 390		1		
FINE	AGG.					COARSE A	GG:					£ 300		1-		
PETROSP		DATA (CRD-C	127)									L			
1		V n·n 1		16.17												
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BENER	L:															
REMARKS	•										-					
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WES FORM 726 JAN, 1951

STATE:	Ark.		IMO	EX NO.: 1(T	ov #2\	Acc.	EFEAT	- 1	75 575	A 80.	TIC	AFWE					_
LAT.:	33		_	6. 92	EV NE J	DATA	SHE	5		0 Fai	100	028 1040	0 4	n 2	063		
		- SET	OVC .	72 0 3		1 3 / Oli 6	· JUE			y re	0 1	9,00,	9 A	DI 1	202		
LAB. SYM	BOL M	o: AT	CV2-	2 3 G-1 ,	300 PC	101/541		TYPE	OF M	ATERIA	LBE	nr g	rave]. &	nat.	. se	mg
LOCATION	<u>- Be</u>	arde	r. A	rk:		<u> </u>	<u>8 s≖1</u>	ع تع نے	b 6	444		سندت			<u> </u>		
				~													_
PRODUCE	: Pi	ne B	luff	Sand ar	Gray	21 Co.											
			·	<u> </u>							_						
SAMPLED	St.	John	Joh	nson. Vi	ksbur	a Dist	rict					-					
YESTED	FOR:	Flat	Bay	ou Drain	eze St	mictur	·é							·			
PROCESSI							_					- -					
								<u> </u>	<u> </u>				·				
<u> </u>				<u> </u>		i											
CCLOCK	AL FO	MATER	U AND	AGE:	<u></u>						-			·			
}						C4-iii-4		000	***************************************		~~~						
				ayou Dra	tnage							·			T -	100	
[(CND		Merce.	T*****	1	116	ST RE	SULT			-1	3-6"	13-3"	3-15	44-	17	ME
SIĒVĒ	-3~6°	13-3"	3-15	44- JU FINE	-		بسنسي							(c)	(c)		GG.
		-		100		. GR , SAT								2,56	-	_	<u>60</u>
ein.			<u> </u>	-		ion, yer c						~		1.8		_10.	7
:51N c		-				- IMPURITH						-					
414.		- ":"	<u> </u>			ARTICLES,					[-			.0.0		1-	_
318.					PER CEN	IT LIGHTE	n THAN S	P. CA.2	1:0	(CRD	C 12	2 \$1		4.6]-	
2 IN.			÷		PLA CEN	IT FLAT A	NO ELONG	ATED (CRD-	Ç [19,12	20):					\top	
_ 2 ·.	- :	2020			WEIGHTE	D. AV. % L	985, 5 CYC	. MgS	O4 ((c)	ţ-1', °.	4-3)(CRO-C	C-115)=	7.8	1		
ji ∳ IŅ,	~		300			N LOSS (C					Ť	-		28. 2		1=	
I'IN:			- 91		+	., LB/CU					$\neg \dagger$				✝┈	+-	
IIN.			52			JMP5, 70 (1-	+	
jin.			18			O LIGNITE			" ?2):				-			_	
ŽiN.			10			HEAT, BT				•24)					+	-}	
NO 4		ينت		 		TY WITH					=	ستن		168	├	16	<u> </u>
NO.6	<u> </u>		┝┯┷		1		innou (. 160)							_	_
NO.16				90	-	- MARING		- /6		Reym				89	<u> </u>	لايل	0
	- 7.5											_	-				_ 1
NO.30			ــــــ			CÈME								25.00	بر. جت	==	<u>.</u>
NO.50		<u> </u>		14	LINEA	THERMA:							5,1267	<u>.</u>			.,
- 110, 100		- '.		5	<u>ا</u> ا	MOCK	TYPE		PARAL	LEL	ACR	1035	9		AVE	MOE]
:0.200			ļ	1 ==	I								L				
- 2000				0.7	l L			i							-		l
F, M(b)			L	2.7				1]
(ē) CÑD-	C 105	(P) CI	ID-C	04	MORTA	VR L		-									
	242 57			AF # 7580	-5 (233)		FINE AC	GREG	ATE		T	. (COARSE	ACCR	CATE		
	D-4 L	, moon		00F, % (CAD	-6 1233	3 MQ.	6 MO.		40.	2 MO.	3	MO.	6 MO		MO.	72 1	10
COW-A	KW. CED	ENT:		To Ne D EOU	WALENT:			5									
HISH-	LN,CEN	ENT:		No No EQU	WALENT:				-			\neg		1			_
SOUNDME	55 IN	COHCR	ETE (CI	10-E 46, 114):		•	<u></u>				-	FBT	HW	-co	HD-	C'W
FINE.	NGG.				COARSE 4	VGG:					DFE	305		+-			
FHE	`~~		-		COARSE A							200		┪			
PETROGR		_	CRD-C	1211:					<u> </u>			<u> </u>		ــــــــــــــــــــــــــــــــــــــ			-
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PLATE 12

FROI:	U. S. APMY LOWER Miss. Valley DIVISION 1800. VICKS-39 PROJECT Felsen					T-0 S-T(ESŢ	US P.	0.	Dra	wer	213	1.	Divis:		
_Jo	b 6606 VICKS-26	Locks SOURCE	Felsen and Da hita Ag	ms			اا	Nat				nd-	gri	vel-		
<u> </u>				COARS	·	۔۔۔۔			<u> </u>							
SIEVE SIZE	SIZE CALCULATION ZEST (Groms)				OF:	TEST TEP	FINE	R TES		1 -	ŤĚ	ŝ.	`	WEIGH COR PER C	RECT	ED.
-		_RUN_2_	RUN 1	•		RUN		171 2		¥ -	RUN	_	RUN_1			
NO. 4 TO \$ 11		750	750_	_68'r.		4.3			35.7		.3	_11,	4		4	٤
<u> </u>	-3	1500	1500	1387.							-5	_7_	7	3.75		.55
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	CONSTITUEN			TICLES	SI	LIT	CHIA							CHUC	TO	TAL
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	76)	- HUN 1	. R.N 25	. RUN -1.	AUN 2	-RUN 1	RA 2	RUN 1	RIN Z
3/8-inNO.4	2			-	٠ -	(16.2)	(18.8)	0.3	0.4
NO. 4.8	13	100	100	83.8	81.2	16.2	18.8	2.1	2.4
NO. 8-18	20	100	100	Olt 14	94.2	5.6	5.8	1,1	1.2
NO. 10.30	20	100	100	97.0	94.5	3.0	5.5	0.6	1.1
NO. 30-50	24	100	100	96.6	95.3	3.4	4.7	0.8	1.1
NC. 50-100	. 14	•		•	•	0.0	0.0	0.0	0.0
NO. 100. PAN	. 7	<u> </u>		• .		0.0	0.0	0.0	6.0
TOTALS	100	400	400	371,8.	365.2	_ 28, 2	34.8	L. Q.	6.2
2.2 . 35	_ ^.					CHTED AVG		11:1	-
	····			- AV	TOTAL WE	ONTED AVG	ENS 1 5 2	= 6	PER CO

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FROM:	Lower Miss, Valley Division MOO VICKS-39 PROJECT Felsent					T () S T 	. 1	USA P.	MESS: EWES O. D. kson	rawe	r 2	131				
SYMBOL VIC JOD 66 SERIAL NO. S=2(2)	o6 vicks-26	PROJECT F LOCKS S SOUNCE St. Fra	nd Dam	<u>s</u>				Nat	erial ural				zrav	ല		
SIEVE SIZE	SIZE CALCULATION TEST (Croms)					FTER	WEIGH FINE AFTE	R SI		5	EVE	G FIII	R	WEIGH COR PER C	RECY	ED
40.4 TO 1 IN	50	750	750 1500	650. 1333.	6.60		99.	1	87.6 75.2		.3	RIN _ll	7	RUN 1 6.65 5.55	5	85 85
	TOTALS	2350 1	<u> </u>	1983.	_		Ŝu	M WE	62.8 IGHTEC HTEC	AVG			2 2			
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						1-6-	-	1-2					26	- 3E		**
								- 								

		*	<u> </u>	FINE A	COMEGATE -				
3/6-inNO.4	GRUDING FOR CALCU- LATION	FRACTIC	OF TEST WS ECTOPE (Greene)		F TEST IS AFTER (Green)	SIEVE AS	NG FINER TEN TEST 3 LOSS		AVY"JCE D % LOSS
	(%)	PUN 1	- MA 2	SUN .1	- AUN 2 _	R(N-1	MAI 2	RIN 1	RUN 2
1/8-; x NO. 4	2.					(20.7)	(16.8)	0.4	0.3
4.8	13	. 100	100	79,3	83.2	20.7	16.8	2.7	2,2
iO. 8-14	20	100	100	94.2	92.8	5.8	7.2	1.2	1.4
16-30	20	_100	100	01.8	_95.6	5.2	i, h	1.0	0.9
10. 30-50	34	100	100	ولا لا	97.4	5.6	2.6	1.3	0.6
10. 50-100	14	•	-	٠		0.0	0.0	0,0	0.0
10. 100- PAN	. 7	•		•		0.0	0.0	0.0	0.0
TOTALS	100	_400 -	400	362.7	369.0	37.3	- 31.0	6.6	5,4
						CHTED AVG	RUNS 1 8-2	12.0	
				AV	TOTAL WE	CHTED AVG	TUNS 1 5 2	6.0	PER CEN

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PLATE 14

FAQN:	U. S. AMY Lower Miss. Valley pivision					T Q	EST	USA	ewes D. D				Div	isio	n	
Lot	er Miss.	Valley	DIVISION	I.	RO-C								pi	392	95	-
Job 660			Felsent		nd C	ali	on		AIAL	can	d a	nd o	rev	e]		_
SERIAL NO.	VICKS-23	SOURCE	Bluff S		nd G	irav	el (
				COARS	E. AGC	RECA	TE						-			
SIEVE SIZE	SIZE CALCULATION TEST (Grame)					TER	FIME	R SI		5	EVE	AFTE	1	WEIGH COR PER C	RECT	ED .
-	(Per Cort)	RUN 1	RUN 2	RUN 1	בו			· - I ··-	Wi-Z	T		SUN	1 -	RUN :		UN 2
NO.4 TO 1 IN		750_	750	650.		_			70.2		.3			<u>6.65</u>	_	.70
_ + TO 1 IN	<u>=0</u>	1500	1500	1353.					34.6		<u>.81</u>	ي.		<u>4.90</u>	_	<u>.50</u>
	YOTALS	2250	2250	2003.	050	15.4			_					1.55		. 20
					—-Î									0.75		
	<u> </u>		T NO	. OF	لتتا	AVG	TOTAL		· - ,	ne realize				0.4	PER.	CEMI
	CONSTITUENT	r	PA	TICLES	-	<u></u>	Torus.		CRAC		_				TO	TAS
					RUN		_	Ru.		NUN 2			RUN	RUN 2		RUN 2
Chert		<u> </u>	- 50	1 46	3	3	10	14	1	ī	10	.5	26	33	50	46
	2 -		-													
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 				FINE	OCREGATE				
SIEVE	GRADING FOR CALCU- LATION	FRACTIC	T OF TEST ONS BEFORE (Grame)		OF TEST NS AFTER (Grand)	SIEVE AF	NG FINIR TEN TEST 3 LOSS		AVERAGE D % LCSS
<u></u>	(K)	RUN 1	RUN 2	RUN 1	AN 2	RUN 1	RUN 2	RUN !	RUN 2
3/8-14NO.4	2.					_=		ì	
10. 4.8	13	_			-				T
O. 8-16	≥0			Î .				Ĭ	
16.30	. 20		T					1	1
FO. 30-50	24		1		<u> </u>		1	1	
10. 50-100	14	•	1	•		0.0	0.0	0.0	0.0
C. 100. PAN-	7					_ C.O	0.0	0.0	0.0
TOTALS	100.					1			
		-			SUM WE	ICHTED AVG	RUNS 1 & 2		
	·			. AV			Res 1 & 2	-	PER CEN

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SERIAL NO.		Standa	urd Grav	rel Co	mer	ıv.	Cam	len.	Ark							-
* ·				COARS	E_AQG	262	TE									
ŠIEVĒ SIZE	SIZE CALCULATION TEST: (Croms)					-1		R SIE	VE	5	EVE TE	G FII	•	WEIGH COR PER C	RECTI	ED
	(P.v Cent)	RUN 1	RUN 2	RUN 1	RU	N 2	RUN	1 5	UN 2	_	N I	ĤUN		RUN-J	R	IN 2
NO.4 TO 1 IN	50	750	750	702	1	42	48		8_	<u>6</u> .	14	1.	1	3.20	0 0	.55
TO I IN	50	1500		1446	_	119			81	1.3.	أعك	_5	<u>4j</u>	1.80	2 2	.70
	TOTALS	2250	2250	2:48	<u> S</u>	61	105		89	10			5	5.00	_	. 25
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-	CONSTITUENT			ITICLES RE TEST	SP	117	CRU				_	KED	sa	NO.	TO	TAL
=	(Stáp % to 7 in.)				RUN	Rus 2		RUN 2	RUG	RUN 2	RUN	RUN 2	RUN	RUN 2	RUN	RUN 2
_ Chert	Chert3				3	1	0	0	2	9_	3	3	31	40	39	12
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 				FINE	CREGATE	`			
SIEVE SIZE	GRADING FOR CALCU- LATION	FRACTIO	OF TEST NS BEFORE (Grains)		OF TEST IS AFTEK (Grame)	SIEVE AF	MG FINER TER TEST % LOSS		AVERAGE D % LOSS
	(X)	RUN 1	RUN 2	RUN 1	RUN Z	RUN 1	RUN 2	RIM I	RUN 2
3/8-INNO.4	2				_	19:21	(6.6)	0.2	21
NO. 4-8	13	100	100	3.00	93.4	9.2	6.6	1.2	0.9
NO. 8-16	20	100	100	97.4	97.1	2.6	2.9	0.5	0.6
NO. 16-30	20	100	100	95.5	95.3	3.5	3.7	0.7	0.7
NO. 30-50	24	100	100	95.6	ο β. τ	4.4	1.7	1.1	0.4
NO. 50-100	14		•			0.5	0.0	0.0	0.0
NO. 100- PAN	. 7	•	•	-•		0.0	0.0	0.5	0.0
TOTALS	100	400	400	380.3	385.1	19.7	11: 9	- 37	2.7
					SUM WE	CHTED AVE	RUNS 1 & 2	6.4	
	_			AV	TOTAL ME	GHED AVG	NAS 1 4 2	3.2	PER CENT

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HOMARKS			-	-	
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PLATE 16

Lc	U. S.	ANNY	DIVISION	SOUNC	REPORT OF SOUNDNESS TEST (CRO-C 175)				USAEWES, Concrete Division P. O. Drawer 2131 Jackson, Mississippi 39205							
Job 660 SERIAL NO. S-2, G-2	VICKS-39	Lock:	s and I	thal a Dams			i	Nat	ural					æl		
	-		~	COAKS	E AGG	AEC.	TE									
SIEVE SIZE	GRADING FOR CALCULATION			WEIGHT FRACTION TEST	NS AF	TER	FINE	R SIE		S	EVE TE	G FII AFTEI ST 3 LO		WEIGH COR PER C	RECT	ED
*-	(Per Com)	RUN 1	RUN 2	RUN 1	RU	N 2	RUN	1 6	UN-Z	RU	1	RUN	2	RUN_1	I A	N Z
NO.4 TO 1	50	745_	1_71	ட	5		39_	یا_ا	7	_5.	2	0.35	<u>1 2</u>	.60		
TC1 11	1470	1149		30		1,	12	له	_0_		1.00		115			
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				·	SUM WEIGHTED AVG MUNS 1 4 2 4.1											
	ندنب بند سب				AVG TOTAL WEIGHTED AVC HUNS 1 & 2 2.0 PER CENT						XNI					
•		_		O. OF	NA MANTICI EC AFTER TEXT						<u></u>					
	CONSTITUENT (Size % to 1 fi		DEF	ORE TEST		_	4	-	CRAC			WED	SOL	~~~	TO	_
			AL		REEN 1	2	RU	RUN	RUN	NUN 2	RUN	RUN 2	RUN	FUN 2	RUN 1	RUN 2
Cher			48	43	ı	Ó	0_	Ô	C	0	٦.	2	110	717	1,2	43
3				1=												
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				FINE A	CRECATE				
SIEVE SIZE	GRADING FOR CALCU- LATION	FRACTIC	OF TEST NS BEFORE (Greens)	WEIGHT OF FRACTION TEST (IS AFTER	SIEVE AF	NG FINER TER TEST % LOSS	WEIGHTED CORRECTE	
	(K)	RER 1	RUN 2	RUN 1	RUN 2	RUN .1	RUN 2	RUN 1	RUN 2
3/8-INNO.4	2		-	Ç		(9.8)	(5.4)	0.2	0.1
NO. 4:8	13	100	100	90,2	94.6	9.8	5.4	1,3	0.7
NO. 8-16	20	100	100	96.8	95.5	3.2	4.5	0.6	0.9
10. 16-30	20	100	100	97.9	97.2	2.1	2.8	0,4	0.6
NO. 30-50	24	100	100	98, 1	95,7	1,9	4.3.	0.5	1.0
NO. 30-100	14	•	•		•	0.0	0.0	0.0	0.0
NO. 100- PAN	_ 7	•			•	0.0	0.0	0.0	0.0
TOTALS	100	490	400	383.0	383,0	17.0	17.0	3.0	3,3
_					SUM WE	CHITED AYE	NUNS 1 & 2	6.3	
-,				AVC	TOTAL WE	CHITED AVE	RUNS 1 & 2	3.2	PER CENT

REMARKS			<u> </u>			-
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COMPUTER	JFJ		11-5-64	<u> L</u>		

REV. DEC. 1955 477

Appendix A

Petrographic Report

Samples

1. Five samples of gravel and five samples of natural sand were received for petrographic analysis on 21 August 1964. They represented four deposits of sand and gravel from the central part of southern Arkansas and one deposit of sand and gravel from an area in Louisiana just south of the others. All of the samples represented processed material taken from stockpiles. Only two of the sands were within the grading limits specified in Corps of Engineers Guide Specifications for Concrate. For the eight samples that were not within the limits, a grading conforming to the middle of that given in the Guide Specifications was assumed for use in calculating sample compositions (table, Al-A5). Sample identifications are given below.

Concrete Division Serial No.	Producer and Source
VICKS-26 G-1(4), S-1(2)	Ouachita Aggregate Co., Inc., Hampton, Arkansas. Champagnolle Creek Deposit, 4 miles west of Highway 167 between Hampton and El Dorado, Arkansas.
VICKS-26 G-2(2), 8-2(2)	St. Trancis F terials Co., Harrell, Arkansas. Harrell's Pit, 3 miles north of Harrell, Arkansas.
VICKS-23 G-1(2); LR-18 S-1(2)	Pine Bluff Sand and Gravel Co., Pine Pluff, Arkansas. 1/4 mile south of Highway 79 on gravel crossroad, approximately 2-1/2 miles west of Bearden, Arkansas.
VICKS-39 G-3, S-3	Standard Gravel Co., Canden, Arkansas. Just north of Camden, Arkansas, north of Highway 79 on Gravel Pit Road.
VICKS-39 G-2, S-2	Monroe Sand and Gravel Co., Sterlington, Louisiana. 1/2 mile west of Sterlington, south on blackton and gravel road.

Test procedure

2. A representative portion of each sieve fraction that amounted to five or more percent of a sample was examined. The particles were classified and counted. A stereoscopic microscope was used as needed for the examination of the gravels. Sand sizes larger than the No. 30 sieve were examined with a stereoscopic microscope. The sizes passing No. 30 sieve

were examined as grain immersion mounts with a polarizing microscope. The refractive index of the immersion liquid used was 1.544. A monochromatic sodium light source was used as needed with a microscope equipped with a Saylor double diaphragm in testing for the presence of chalcedonic chert. (Chert having an aggregate refractive index below 1.544 is regarded as chalcedonic chert.) Since each pair of sand and gravel samples came from a common source, the search for chalcedonic chert was restricted to the sand sizes. It was thus assumed that chalcedonic chert is either present or absent in both the sand and the gravel.

Results of examination

- 3. a. Gravels. All of the gravels are composed largely of blocky chert particles with minor amounts of quartz particles.

 Dense chert particles make up from 59 to 85 percent of the samples. Particles of vuggy, fractured, or porous chert are present in small to moderate amounts (tables Al-A5).
 - b. Sands. The sands are also composed largely of chert and of quartz particles, but quartz is the dominant constituent, amounting to 63 to 73 percent of the total sample (tables Al-A5). Some chalcedonic chert was found in three of the sands. These were VICKS-26 S-1(2), VICKS-39 S-3, and VICKS-39 S-2 (tables Al, A4, and A5, respectively).

Description of constituents

- 4. a. Dense chert. The particles are blocky with rounded edges, dominantly brown, with many black and light-gray particles.
 - b. Porous chert. The porous particles are typically white or tan, tabular in shape with rounded edges, and would be expected to make popouts in concrete surfaces. The particles with porous rims have dense cores and porous rims up to 1/8 in. thick. Dense particles with some porous surface were counted as chert with porous rims. It is not known whether particles with porous rims will form popouts in concrete surfaces. As particle size decreases, the porous particles cannot be separated into "rimmed" and "not rimmed."

- c. Vuggy chert. Particles with many reentrants on their surfaces are classed in this group. They are lost, by breaking into smaller pieces without reentrants, in sizes passing the 3/4-in. sieve. They amounted to from a trace to 8 percent in the samples examined (tables Al-A5).
- d. Fractured chert. The particles contain incipient fractures and are expected to break into smaller pieces in the mixer. They diminish in fractions passing the 3/4-in. sieve. Fractured chert amounted to from a trace to 11 percent in the samples examined (tables Al-A5).

e. Quartz.

- (1) Gravels. The particles are blocky with rounded edges and many surface reentrants. They are translucent white to tan with some orange shading. The quartz particles are composed of intergrown quartz crystals, and represent vein quartz surviving longer than the sandstone that criginally contained them. A few sandstone fragments contained quartz veins crossing the bedding.
- (2) Sands. The quartz particles in the sand are generally transparent single crystals of variable particle shapes and rounded edges.
- f. Miscellaneous. Sandstone or quartite particles make up most of this category in the gravels. The tan sandstone and quartite are silica-cemented. A few pieces of iron oxide conglomerate are present in the gravels. In the sands many miscellaneous particles are acid igneous rocks.
- g. Feldspar. A small amount of tlocky pinkish orthoclase and microcline particles were found in VICKS-39 S-2, VICKS-39 S-3, and VICKS-26 S-1(2). No feldspar was found in the other two sands or in the gravels.

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Summary

- 5. Samples from five deposits of sand and gravel have been examined. All represented commercially processed aggregate. Chert made up about 80 to 96 percent of each gravel (tables Al-A5). Most of the chert was dense. The rest of the gravels was largely vein quartz.
- 6. The sands contained 63 to 73 percent quartz with chert the second most abundant constituent (tables A1-A5). Some chalcedonic chert was found in the samples from the Monroe Sand and Gravel Co. (VICKS-39 S-2), the Standard Gravel Co. (VICKS-39 S-3), and the Ouachita Aggregate Co. (VICKS-26 S-1(2)). Chert in each of these aggregates amounted to more than 20 percent; under the requirements of EM 1110-2-2000 of 15 December 1963, low-alkali cement should be used if any of these aggregates are used.
- 7. The sand from the Monroe Sand and Gravel Co. was dirty; the larger grains were coated with smaller grains, and the smaller grains were partially coated with reddish clay.
- 8. Three of the sources, the Quachita Aggregate Co., the St. Francis Materials Co., and the Fine Bluff Sand and Gravel Co., had been sampled previously, but previous samples were not examined petrographically.

Tuble Al

Composition of Gravel and Sand from the Ougchita near Ht mpton, Arkansas, VICKS-26

	Sand	27 Trace	-		7.	Q	100
Weighted Average Composition, %**	No. 4 to 3/4-in.		۲, ۲,	بارهی	8	Trace	100
Weight	3/4- to 1-1/2-in.		68 Trace	اسروب	. 91	a CU	700
-	100	ထ			ر و	- -1	007
	No. 20	12	t -	-	87	ţr	1001
Steve	88	27			73	α	100
ned or	No. 16	24			56	ત્ય	007
Retal	ω	57	Ī		38	5	1 8
Fractions Reta	3.4	-	66	4	80	-	137
Composition of Fractions Retained on Sieves	3/8- in.		(89	°i}	21	Н	100
osition	1/2- 110.		73	ጓ ເഗ ભ	17	Ä	100
Ccmi	3/4- in.		67	- - - - -	17	러	100
-1	- si		89	5 01 01	16	ત્ય	100
	Constituents	Chert	Chalcedonic	Vuggy Fractured Porous rim Porous	Quartz	Miscellaneoust	Total

Based on examination of 300 or more particles in each size shown except the 1-in.; it consisted of 131 particles.

Percentage calculated using the composition of sieve fractions shown above and a grading taken from the middle of that given in Juide Specifications for Concrete, CE 1401.01, Aug 1963. Composed of sandstone, quartiite, and assorted rock fragments.

Table A2

Composition of Gravel and Sand from the St.

rerage	ិយ	50			į	2	႕		100	
	3/4-in-		Trace	11	: ,	7.7	٦.		100	
	No. No.	සා				92	aceaL	1	Š) }
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a Sieve	잃잂	†?				75	•	1	į,	5
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of Fract	No.		1	.	[]	ָרָ <i>ב</i>	ā	႕	1	100
osition	No.		67	*	, ω	Š	Q N	ત		100
Comp	1/2-		Z.	į	o - †	-	28	Н		300
	3/4-		20	Ġ	ው«	n	ä	ત્ય	1	100
	-	Constituents	Churt Dense	Vugig/ Fractured	Poroue rim	Porous	Quartz	Macellaneoust		Total

Percentage calculated using the composition of sieve fructions shown above and a grading taken from the middle of that given in Guiue Specifications for Concrete, CE 1401.01, Aug 1963. Composed of sandstone, quartite, and ascorted rock particles. Based on the examination of 300 or more particles in each size shown above.

Table A3

Company Composition of Gravel, and Sand from the Pine Bluff Sand and Gravel

	-	Com	Composition of Fractions Retained on Sieves Shown Belcw, 6*	of Fr	Fractions Reta	Retai	ned on	Sieve	ŵ -	-	Welgh Comp	Weighted Average Composition, %	
Constituents	구드	3/4- in.	1/2- in.	3/8- in:	Š T	ည့်ထ	ું જુ	양 있	N 00	100	3/4- to 1-1/2-in.**	No. 4 to 3/4-in.**	Sandt
Chert Donse Vuget	57	₹ 4	<u>й</u> н	99	472	65	63	<u>1</u> 44	† *	13	59 Trace	70 Trace	34
Fractured Porous rim Rercus	7 H 6	ָה על גע ביי	फ़ेल् <i>०</i>	176	{12					-	{s ₃	\{16	
- Questa	70	12	σ	Ħ	ካፒ	56	က [±] က	ئر. ئا:	85	85	77	Et	63
Mscellaneoustt	100	100	Trace 100	1007	Trace 100	100	7000	100	100	100	100	100	100
									-				

Based on examination of 300 or more particles in each fraction shown except the 1-in.; it consisted of 108 particles.

Percentage calculated using the composition of sieve fractions shown above and a grading taken from the middle of that given in Guide Specifications for Concrete, CE 1401.01, Aug 1963.

Percentage based on the composition by sieve fractions and on the grading of the sample. For this calculation the smell amount of sample not examined was assumed to have the composition of the adjoining size. Composed of sandstone, quartzite, and assorted rock particles.

Table Ah

Composition of Gravel and Sand from the Etsindard Gravel Company Camden, Arkansas, VICKS-39

		Sand	27 Trace		-		(ò	<i>#</i>		8	
Weighted Average Composition, %**	No. 4 to	3/4-in.		85		ſſ		3 3	αı		001	
Weigh	2/12 to	1-1/2-in.		7.	rन	14	o	t	ы		S) } {
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of Fra	30 10 10 10	3/8- No. No.	N approximately	Ğ	o V		ľ	vo			Hamilton and the second	ş
Composition of Fractions Retained on Sleved	-	1/2- 3/8-		Š	Q.(22011	īV	ţ	٠,	-}	gand Spanisterife d	200
Comp		3/4-	. 1.1.1.	4	다. 다.	20017	~#	V		-1	iga begad idas medi:	દુ
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pour personne mente representat l'up étique des seus décisions procés de la composition della composit		-	Constlement	Chert Chaicedown	Dense	Vuexy	Fractured Forest	1 di	Strains	Miscelienoonst		Total

pased on examination of 300 or more particles in each size shown except the 1-in.; it consisted of

Perceitage calculated using the composition of sleve fractions shown above and a grading taken from the middle of that given in Suide Specifications for Concrete, CE 1401.01, Aug 1963.

Composed of sandstone, quartzite, and essorted rock fragments.

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Table A5

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Composition of Gravel and Sand from the Wohroe Sand and Gravel Company Sterlington, Louislana, VICKS-39 G-2, S-2

3ge 1,	:	~,	Sand	र्ट	ر				7.	5	ო	100
/eighted Averag Composition, ತೆ.	No. 4 to	3/4-	in. **	-	<i>1</i> 92	Trace	113	٠	 o	н	-	100
Weight Compos	3/4- to	₹	** **		88	3 (r	ر ش	ر	H	m		100
		⊙	읽	<u></u>	را				. 70	ន្ត	ಚ	100
		કૂ જુ	20	90	.2				జ్ఞ	છ	က	100
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ieve		o လ	9	33					9	4	m	100
l on		9	ω 	52					1 7	9	H	100
etaine	*	- -=	Sand	78					51	ฑั		100
ition of Fractions Retained on Sieves	Shown Below, %*	Š	Gravel		92		11	وب	강	н	-	100
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		1-1/2-	in.		æ 3	ac)			10	-	100
-			Constituents	Chert	Dense Viveni	Transfered	Forcus rim) 	quartz	Missellaneoustt	Feldspar	Total

Hannd on examination of 300 or more particles in each sieve fraction shown except the 1-1/2-in. No. 4 of the sand; the 1-1/2-in. size consisted of 50 particles, and the No. 4 size of the sand contained 68 particles.

Percentage calculated using the composition of slove fractions shown above and a grading taken from the middle of that given in Guide Specifications for Concrete, CE 1401.01, Aug 1963. The material Fercentage based on the composition by sieve fractions and on the grading of the sample. The materi passing No. 100 sleve was assumed to have a composition like the No. 100 sleve size material for this

calculation. 17 Composed of sandstone, quartzite, and assorted rock particles.